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NATIONAL NON-FUEL MINERALS POLICY PLANNING PROCESS

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NMAB-384

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NATIONAL NON-FUEL MINERALS POLICY PLANNING PROCESS

REPORT OF
THE COMMITTEE ON THE REQUIREMENTS FOR A
NATIONAL MATERIALS POLICY PLANNING PROCESS

NATIONAL MATERIALS ADVISORY BOARD
COMMISSION ON SOCIOTECHNICAL SYSTEMS
NATIONAL RESEARCH COUNCIL

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NOTICE: The project that is the subject of this report was approved by the Governing Board of the National Research Council, whose members are drawn from the Councils of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine. The members of the committee responsible for the report were chosen for their special competence and with regard for appropriate balance.

The report has been reviewed by a group other than the authors according to procedures approved by a Report Review Committee consisting of members of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine.

The National Research Council was established by the National Academy of Sciences in 1916 to associate the broad community of science and technology with the Academy's purposes of furthering knowledge and of advising the federal government. The Council operates in accordance with general policies determined by the Academy under the authority of its congressional charter of 1863, which established the Academy as a private, nonprofit, self-governing membership corporation. The Council has become the principal operating agency of both the National Academy of Sciences and the National Academy of Engineering in the conduct of their services to the government, the public, and the scientific and engineering communities. It is administered jointly by both Academies and the Institute of Medicine. The National Academy of Engineering and the Institute of Medicine were established in 1964 and 1970, respectively, under the charter of the National Academy of Sciences.

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ABSTRACT

The requirements for a non-fuel minerals policy planning process are examined in terms of how non-fuel minerals issues are brought to executive and legislative attention and the adequacy of data collection and analysis. The behavior of the policy process is examined, particularly in terms of the reports to Congress under the Mining and Minerals Policy Act of 1970. Recommendations are made for strengthening the existing policy process by consolidating the non-fuel minerals data and analysis function, assuring that non-fuel minerals supply system concerns are included in the decision process, considering elimination of those provisions of the Mining and Materials Policy Act of 1970 that relate to the reporting process, and establishing procedures for executive- and congressional-level attention to the annual evaluation of the non-fuel minerals supply system.

PREFACE

National materials policy, particularly non-fuel minerals policy, has been a continuing concern since the end of World War II. Since 1950 the subject has been thoroughly examined in a series of major studies by various administrations and presidential or congressional commissions. This committee was not charged with looking at the content of U.S. materials policies. Rather it was asked by the General Accounting Office to examine the policy process by which materials issues are brought to executive and legislative attention and are resolved by actions of the President and the Congress.

It is very important to emphasize that the committee was examining the policy process and not the policy. As pointed out in the report, it was always difficult--in the committee's examination--to distinguish between the impact of a policy action (or nonaction) and the process that brought the problem to the attention of the decision makers.

The committee was requested to examine the requirements for a national materials policy planning process, including defining a process that can be used by others in identifying the problems and goals of national materials policy and examining alternate processes for addressing the goals. Alternative institutional prescriptions for such processes were also to be suggested, with reference to each of the possible goals and the attendant processes outlined. Suggestions for new or modified institutional arrangements could result from this examination, but any proposed institutional arrangements were to have an interface with the rest of the federal establishment.

Early in its deliberations, after lengthy discussion of the appropriate scope for the study, the committee agreed to limit the study to non-fuel minerals and identified two topics worthy of further pursuit. They are the annual reporting process called for by the Mining and Minerals Policy Act of 1970 and the role of information and analysis in the materials policy process. Those topics are discussed in Chapters 2 and 3.

There is a wide diversity of strongly-held opinions on materials policy and materials policy development. The conclusions and recommendations presented in Chapter 1 represent the consensus of this committee.

William A. Vogely, Chairman

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CHAPTER 1

FINDINGS AND RECOMMENDATIONS

The committee had available to it a recent series of exhaustive examinations of materials policy issues. These examinations [1-23] included the work of two major commissions within the past decade [2, 4] and a study initiated by the Carter administration which is still continuing within the executive branch.[6] These three studies were supplemented by a series of reports by the General Accounting Office [1, 7, 8] and by continuing attention to the problem through congressional hearings,[9] especially those leading to the enactment of the Materials and Minerals Policy, Research and Development Act of 1980.[10] In view of this mass of information, the committee decided that there was no need for further development of the basic facts concerning the materials issues faced by the U.S. economy. Instead, after reviewing the available reports and records, the committee turned its attention to the behavior of the policy process in identifying emerging issues.

The committee agreed that the essential elements of the present planning process are (1) the manner in which materials issues are brought to the attention of persons in the legislative and executive branches who are responsible for policy formulation, and (2) the data collection and analysis upon which policy decisions are made.

At present, materials issues are brought to the attention of legislative and executive policy formulators by a variety of means, both formal and informal. The formal vehicle for calling non-fuel minerals issues to the attention of Congress is the annual report submitted by the Secretary of the Interior under the provisions of the Mining and Minerals Policy Act of 1970. This function and its effectiveness are described in Chapter 2.

The information upon which policy decisions are based is collected and analyzed by several agencies, primarily the Bureau of Mines and the Geological Survey in the Department of the Interior and the Office of Business Analysis in the Department of Commerce. However, there is no overall responsibility for supervising the collection and analysis of information. There is also a need for a better understanding of the requirements of the non-fuel minerals information and analysis system. Chapter 3 of this report discusses the basic principles of data collection and analysis systems and relates them to the non-fuel minerals information needs.

FINDINGS

1. The non-fuel minerals supply system, while a subject of constant policy attention since the end of World War II, has sustained no failure of the policy process that caused significant damage to the national welfare. On the contrary, events that have interrupted supplies have been handled by the public and private sectors in a manner that has imposed neither significant costs nor limitations on the economy. Thus past experience alone does not justify a major revision of the existing policy process.

This finding, which the committee believes is extremely significant, reflects the most highly debated issue we faced. The committee was challenged by several of its members with long and broad experience in the government, academia, and industry to cite a single case of significant damage to society resulting from a failure in the policy process. In this examination, it was always difficult to distinguish between the impact of a policy action or nonaction and the process that brought the problem to the attention of the decision makers. It must be emphasized that this finding says nothing about the wisdom or lack thereof of the materials policies actually pursued since World War II. Rather, it means that there is no evidence that non-fuel minerals issues were not brought promptly to the attention of decision makers or that decision makers did not address such issues within the constraints of the information at hand.

The events in the non-fuel minerals sector that imposed the most cost on the U.S. economy were the copper, aluminum, and other commodity shortages experienced during 1973-75. These shortages caused price increases and temporary disruptions of supply, but did not result in extensive dislocations in the economy. The National Commission on Supplies and Shortages was established and it examined the events leading up to the shortages in great detail.[3-5] The commission pointed to shortcomings in the information system, and these will be considered later. It is clear, however, that the shortages during that period were the result of a wide-ranging set of policy actions whose implications were fully explored, well understood, and vigorously debated in the political arena. The report contained no evidence, and the committee could find none, that these policies, primarily the imposition of general price controls in 1971, were not debated and understood by those engaged in the policy process. Specifically, the impact of the major environmental thrust of the late 1960's and early 1970's was discussed and reported to the President and the Congress by the National Commission on Materials Policy.[2] In short, the committee found that policy makers, under the current process, had examined materials issues in some depth; we could find no instance of substantial damage resulting from a failure to raise the issues to the decision level.

2. There exists a continuing concern that the potential for major stress on the materials system is present, that strategies and mitigating actions designed to prevent serious disruptions to the economy are not in place, and that the mechanisms in place are inadequate to foresee or develop contingency plans for such disruptions.

In spite of the finding that the policy process has been sufficient to cause materials issues to be considered, such issues remain high on the public agenda for debate and action. In October 1980, Congress enacted the National Materials and Minerals Policy, Research and Development Act of 1980[10]. The act requires that the President and the executive branch examine once again the range of organizational and informational activities dealing with materials and propose changes in the system to the Congress. This move followed a series of such efforts throughout the 1970's. In spite of this major attention by the administration, the Congress, and the private sector, through participation in commission studies, concern persists that there is substantial potential for damage to the U.S. from interruptions of the supply of strategic materials.

The fact that this concern has not been allayed by the continuing flow of responsible analyses and reports on materials issues indicates that the policy process, while successfully raising such issues for decision as they actually occurred, has not generated confidence among materials producers and users that the potential for damage was being properly considered at the highest levels of the executive branch. The number of reports on this subject in the cited literature supports this finding. Concern about materials issues is continuing, if not increasing, as shown by the current attention of the private sector and executive branch to issues such as a "resource war."

3. Concerns about materials supplies are focused in part on actions that have other societal objectives, but that have long-term and poorly understood materials implications and may impose costs that are not considered in the decision process.

Much of the concern about materials issues expressed in Finding 2 centers around the long term effects of federal land-use policies and environmental regulations on the availability and use of materials. In response to this concern, the Carter administration required new regulations to be examined closely for their economic impact. The present administration has very recently strengthened this requirement. The draft report of the 1978-79 non-fuel minerals review[6] also indicated a concern about the lack of information on the resources that underlie much of the public land and the inability to take into account the opportunity cost of these resources in land-use decisions. The concerns about environmental decisions arise because many environmental standards are necessarily based on fragmentary information about impacts, and the levels of pollutants that cause them and because the rigidities imposed on the regulatory agencies by law do not allow sufficient flexibility. Concern with the human rights policies of some supplier nations also has a potential impact on mineral suppliers.

4. The reports submitted under the Mining and Minerals Policy Act of 1970 have not provided assurance that materials concerns are incorporated in federal decision making and properly presented to the President and the Congress.

This finding is based on the paper prepared by the committee specifically for this report and presented as Chapter 2. The evidence presented indicates that the annual report of the Secretary of Interior presently required has not provided the necessary assurance to the interested public. Witness the continuing public concern about materials described in Findings 2 and 3.

5. Two important factors in the public perception that the materials policy process is inadequate are deficiencies in the data systems and analytical capabilities.

Studies on materials [1-4,13,14] have consistently found that the data system and analytical capabilities are deficient. Because of the persistence of these findings, the committee prepared a report on information and analysis that is presented as Chapter 3 of this document. The major conclusions of this report are that (1) it is essentially impossible and not cost effective to try to develop an all encompassing data system, (2) there are clear inefficiencies in the current data system and (3) the data and analysis system could be improved by functional consolidation and professional direction with little or no increase in the resources devoted to materials data collection and analysis.

6. The Materials and Minerals Policy, Research and Development Act of 1980, among many other things, provides a mechanism for addressing the procedures for handling materials issues and the collection and analysis of data.

The act of 1980 is very broad, dealing with all stages of the materials cycle and with coordination of the role of federal agencies in many areas of research and development. It directs the Director of the Office of Science and Technology Policy to coordinate research and development activities and to prepare an assessment of national materials needs related to scientific and technical changes. It also requires the Secretaries of Commerce and Defense to prepare reports for Congress assessing critical materials needs and requires the Secretary of the Interior, among other things, to improve the capacity of the Bureau of Mines to assess international minerals supplies and improve the availability and analysis of minerals data in federal land use decisionmaking. Furthermore, it assigns to the Secretary of the Interior the responsibility to collect, evaluate, and analyze information concerning mineral occurrence, production, and use. However, the act does not assign continuing responsibility for assuring that concerns about the non-fuel minerals supply system are included in the decision process. Section 5 of the Act also requires the President to submit to the Congress within a year a program plan for policy analysis and recommendation for the collection and analysis of materials supply and demand information, including consideration of a separate minerals information agency patterned after the Bureau of Labor Statistics.

RECOMMENDATIONS

The committee's findings show no need for a massive overhaul of the policy process for materials. The existing process has provided responses and brought emerging materials problems to the decision makers' attention. However, the findings indicate that there are continuing concerns that require the attention of the executive branch and the Congress so that the interested public will be assured that materials issues are being handled properly by the political system. The following recommendations are made:

1. The existing policy process should be strengthened by more efficient and effective use of the resources now devoted to the materials data collection and analysis function. One way to do this would be to consolidate in a single agency those functions of the Departments of the Interior and Commerce that deal with non-fuel minerals data collection and analysis. This agency should be professional in nature, headed by a qualified professional serving for a fixed term, and assisted by an advisory committee drawn from the many disciplines involved in the materials field.

The committee recognizes that such a consolidation would involve some initial monetary costs and organizational adjustments, but believes that the benefits would outweigh the costs. Further, the committee does not feel strongly that the organizational solution suggested is the only possible one. For example, an alternative would be to have a centralized, independent analysis responsibility, using existing or improved collection capabilities in the appropriate agencies. Organization is not nearly so important as staffing with appropriate professionals, such as statisticians, modelers, commodity experts, economists, mining engineers, etc., and a clear concept of the nature of the gaps in the analytical data. The Bureau of Labor Statistics is a good example of an effective organization. The major existing gap is in the understanding of minerals endowments in the earth's crust and the potential for developing new supplies from unexplored areas of the crust. The committee notes that the proposal made here is also a specific option for attention by the President in his report to the Congress under the act of 1980.

2. Consideration should be given to assigning to an official in the executive office of the President continuing responsibility for assuring that concerns about the non-fuel minerals supply system are included in the decision process. For example, evaluation of the state of the materials supply system, with specific emphasis on early warning, could be included in the annual report of the Council of Economic Advisers to the Joint Economic Committee of the Congress, and that committee could call to the attention of the appropriate House and Senate committees any issues that required congressional attention. The same official should also be assigned responsibility for oversight review of the non-fuel minerals policy process.

This recommendation attempts to rectify the major inadequacy of the procedures prescribed by the Mining and Minerals Policy Act of 1970 as well as other procedural shortcomings, especially those identified by the National Commission on Supplies and Shortages. The recommendation is two-pronged: it addresses both the perception that materials issues somehow get lost at the highest decision levels in the government and the problem of a report that is submitted to the Congress but upon which no congressional committee is required to take action. This committee believes that the failures of the policy process certainly do not themselves justify the establishment of a major structure within the Executive Office of the President. In searching for a proper place to recommend the assignment of responsibility to handle these concerns, the committee felt that considerations of the materials supply system should be assigned specifically to an existing office responsible for reporting to a specific congressional committee.

A major argument for our suggestion is that materials problems will have their initial impact on the economy of the country and through that on the national security and national welfare. Thus, the Council of Economic Advisers, which is responsible to the President for examining the health of the economy, seems a proper place for specific responsibility. One member of the three-member council traditionally has been assigned responsibility for natural resources. Therefore, the materials assignment called for here should require no substantial additional procedures or expenditures in the executive office. The detailed information needed to prepare the report would, of course, have to be obtained from the operating agencies responsible for the various aspects of materials resource availability and close coordination with those agencies on a continuing basis would be essential.

An equally important consideration in developing this recommendation is the long history of extensive hearings on the Economic Report of the President by a joint committee of the Congress. This mechanism calls emerging problems to the attention of the Congress in a nonlegislative context. Thus the mechanism could be used to assure that the report of the executive branch on materials issues has both a designated executive branch home and an audience in both houses of the Congress.

The importance of early warning should be emphasized since the need for remedies such as substitution for a material or the capability for recovery of materials in lower grade domestic resources must be foreseen and action taken early and quickly. The trends toward shortages are often discernible years prior to the actual scarcity.

3. Consideration should be given to eliminating those provisions of the Mining and Minerals Policy Act of 1970 that relate to the reporting process.

As indicated in Chapter 2 of this report, the reports under the Mining and Minerals Policy Act of 1970 have not achieved their intended goals. The act of 1980 provides a mechanism for developing better procedures, and this report offers recommendations on what those procedures might be.

4. The executive response to the provisions of the act of 1980 should take into account the shortcomings of the 1970 Act discussed and should stipulate improved procedures for executive-branch and congressional attention to an annual evaluation of the materials supply system.

This recommendation highlights what the committee believes to be the major reason for the continuing concerns about materials problems expressed in the findings. We believe that these concerns flow from the perception that materials issues are not being considered at the proper level in the public decision-making system. The 1970 Act placed responsibility on the Secretary of the Interior. This responsibility, for the reasons given in Chapter 2, apparently could not be effectively carried out. Nor is Congress organized to act upon informational reports on emerging issues that do not specifically require that the issues be examined by a substantive committee. Hence such issues reports simply get lost in the pressure of day-to-day activities. We believe that our recommendations provide mechanisms for alleviating the continuing concerns expressed in the findings. At the same time, the recommendations avoid unnecessarily cumbersome and expensive policy processes whose costs to society in the form of delay of decisions and increased red tape would outweigh their benefits.

CHAPTER 2

U.S. MINERALS POLICY PROCESS UNDER THE MINING AND MINERALS POLICY ACT OF 1970

INTRODUCTION

During the past two decades, two very strong and opposed perceptions dominated most informed thought on the need for United States policy on minerals and energy and the form it should take. On the one hand was the perception that the federal government must intervene as necessary to guarantee the needed flow of critical minerals and fuels to the United States economy; on the other was the perception that the market system, operated by private enterprise with minimal government interference, could and would meet U.S. mineral needs. Both positions are believed by their proponents to reflect current needs in a rapidly changing pattern of minerals supply and demand.

The environmental, conservation and health and safety legislation of the 1960's caused a number of mineral policy issues to rise to high visibility. At the same time, the security and availability of United States mineral supplies, both at home and abroad, were challenged severely by evolving domestic economic patterns and by events in the emerging nations. Chief among these was the growing desire of resource-producing nations to add to their economic development by introducing processing to their portion of the materials cycle, thus keeping the value added at home. Multinational mining companies were quick to adapt to this new alignment. In addition, growing worldwide demand for mineral resources increased competition, especially for supply-limited minerals, and increased the United States import account in both tonnage and dollars.

In this milieu, a number of issues provided recurrent mineral policy themes throughout the 1970's. Some of them clearly required federal intervention. But without an adequate dialogue about the nature of policy making and responsibility for implementation within the bureaucracy, the issues of the 1970's are even more acute in 1980. Those that require government action include import policy, the strategic stockpile, exploration and development of public lands, and environmental constraints in all parts of the materials cycle.

Traditionally, as well as by Act of Congress, the Department of the Interior has been the lead agency of government in devising and implementing policy on minerals and energy. However, if a policy aimed

at short-term needs and long-term goals is to succeed, some consistency of action is required from all government agencies that affect mineral policy. For minerals in particular, energy, business, taxation, trade, transportation, and industry organization and economic regulation are all in separate agencies that propose and implement differing levels of policy and policy direction. It is obvious that Interior alone can not direct coordinated government action in minerals policy.

In this context, the Mining and Minerals Policy Act of 1970 was passed into law. It requires that the Secretary of the Interior report to Congress each year on the state of the mining and minerals industry and recommend legislation needed to keep the U.S. industry viable domestically. It is not known how seriously Congress views the annual report as a vehicle for policy initiation by the executive branch. The legislative record on the Act does not clarify the congressional intent, since oversight hearings have not been held on the implementation of the Act. Nevertheless, the requirements of the Act do provide an opportunity for the report to be used as a policy document.

REVIEW OF THE ANNUAL REPORTS OF THE SECRETARY OF THE INTERIOR

A review of the Secretary of the Interior's annual reports[11] under the act of 1970 clearly shows the problem associated with the document as a policy statement. Through the 1970's the report evolved from a simplified, illustrated statement of the importance of mineral resources to the U.S. economy to an extensive, sophisticated statement of mineral resource issues. However, there were only two explicit recommendations for action in the 1977 report. The 1979 report [11], the last of the series, was issued after the formation of the Department of Energy and the transfer of energy policy to that agency and after the start of the President's Nonfuel Minerals Policy Study. That report carefully avoided all policy issues in favor of a description of Interior's minerals programs. In addition, the annual reports contained commodity information for the previous year, commonly in the form of an appendix, which was a useful data base for summary purposes.

The mining and minerals issues identified in the annual reports present a recurring theme throughout the 1970's. Early reports (e.g., 1973) identify the major problems in the minerals industry as an inadequate information base, restrictive public land management, inadequate capital financing of reclamation, inadequate transport systems, unfavorable foreign trade balance, potential cartelization, and actual and potential expropriation. Unfortunately, the discussion of the problems was not in enough detail and the problems were not sufficiently identified in terms of either short-term needs or long-term goals to provide an agenda for action.

The early reports did not propose solutions for the problems identified nor identify short-term objectives amenable to resolution by cooperative action led by the executive department. Nor did they identify long-term goals, whose achievement would perhaps require federal legislation or executive orders. Instead, the reports contained only

general statements of problems and solutions, without suggesting solutions or indicating concern.

In 1974, a panel of the Committee on Mineral Resources and the Environment (COMRATE) of the National Research Council (NRC) was convened to critique the earlier annual reports and to help the Department of the Interior plan for the 1975 report. The committee worked for almost a year; the one tangible result was the expanded commodity tables published as an appendix to the 1975 report. More importantly, the committee's informal report to Interior identified the major obstacles in producing a more informative, usable and policy-oriented document. Chief among the problems cited concerning preparation of information and analysis in thereport was the limited contact the preparers had with other federal agencies--agencies that themselves had a strong vested interest in minerals and energy policy. Little attempt was made to collect a coordinated information base or to involve government professionals outside of Interior in the analysis of problems and proposals for solution.

Additionally, the early reports did not adequately survey the condition of the minerals industry as perceived by the industry itself. The reports did not sort hearsay from fact with regard to industry structure and health nor did they unambiguously characterize public interest in a productive, competitive, and low-cost minerals industry.

Finally, the 1974 NRC committee commented on what it perceived to be additional shortcomings in structure and content in the early reports. These included the lack of development of an analytical framework to relate the problems of the minerals sector to economic growth in other sectors; the static treatment of issues, leading to inadequate conclusions about short-term needs and long-term policy goals; the need for studies on impact of social and environmental concerns on the introduction and operation of new technology; health and safety in mineral production; the siting and permitting of new mining ventures in rural and undisturbed parts of the country; flexibility, in or absence of, design and implementation of policy; and efforts to increase the efficiency of use of minerals, reducing the rate of growth of per capita demand for them.

The 1977 annual report had a new format and a greatly expanded discussion of the mineral and energy issues that faced the nation. However, it contained few specific recommendations for change or initiation of policy and it did not include an action plan for those recommendations that were presented. Highlighted in the document were mineral and energy issues arising from restrictions on access to federal land for exploration and development; Alaskan land status; use of the Outer Continental Shelf; ocean mining; environmental restrictions on the use of coal; and the changing conditions in international trade in material resources, including the changing character of political

accessibility of minerals (i.e. restrictions on accessibility for political reasons). Although the report did include many of the critical policy issues of that time and each issue was strongly supported by a knowledgeable and lucid discussion, the absence of well developed recommendations to deal with the policy issues detracted from its value as a policy-initiating instrument. In addition, timely implementation of at least one recommendation--on assessing the standards for air quality related to the use of coal--required the active support of another federal agency, the Environmental Protection Agency. That support was not forthcoming.

The 1979 annual report, as noted earlier, appeared after the Department of Energy was organized and assumed most of Interior's energy responsibilities. In addition, the President had initiated a Nonfuel Minerals Policy Review by the executive department. Therefore, the Secretary of the Interior omitted all reference to energy and minerals policy in the 1979 annual report. The document was limited to a review of Interior's ongoing programs related to minerals and a description of new program initiatives for the future.

CONSTRAINTS OF POLICY FORMULATION UNDER THE ACT

The clearance procedures within the government provide some insight as to why the Secretary of the Interior's annual report failed to evolve into a policy document. From early in its history, a draft of the report was sent to the Office of Management and Budget (OMB) for review, revision, and editing. As far as we can ascertain, the report was not reviewed by other agencies of government, the Domestic Council (the Domestic Policy Staff since 1978), or the Cabinet. The OMB review, through the years, concentrated upon budget implications and rarely concerned itself with the issues. Government expenditures, particularly for programs or initiatives with low public visibility, were always constrained by budget limitations, and OMB consistently objected to recommendations that might have required additional funds.

It also appears, in hindsight, that Interior itself was perhaps not sure of the usefulness of the annual report as a policy document, at least in the earlier years. Since oversight hearings on the act were not held, Interior had little opportunity to follow up the report with direct testimony. Therefore, the chances of the report's reaching a wide audience, even in Congress, were unlikely. The report is transmitted routinely to the Congress, with a copy to the leadership of each house. For the staffs of appropriate House and Senate committees to coordinate their efforts in formulating policy initiatives that are translatable into legislation, without the involvement of the executive department, is perhaps asking more than the system can provide. The Secretary of the Interior is also faced with a dilemma in the content of the report. Regardless of what is recommended by his staff associates for inclusion in the report, the Secretary cannot go forward with recommendations or initiatives that are not cleared by the President. To get presidential

clearance on most of the critical materials issues faced today, an integrated policy-development effort--one that must gain adherence through discussions in the Cabinet and Domestic Policy Staff--is required.

Perhaps one of the most important constraints on the report's utility is the lack of organizational rationale in the document itself. As noted by others, including the General Accounting Office (GAO), the coherent application of any materials policy must involve flexible definition of long-term goals, coupled with consistent policy actions derived from short-term needs. It is fundamental to the successful application of a national policy to be able to articulate how each short-term action promotes the goals of the government in enhancing economic and social benefits over the long term. Deviation from the goals, or inconsistencies in short-term decisions, must be explained and rationalized. Given the level of initial preparation of the annual report, and the narrow final perception of its utility, it is unlikely that the report can provide the necessary authority to speak for the government about long-term goals and ways to achieve them. For the report to be an action document, either legislatively or through executive mandate, it must incorporate clear statements of policy formulated in some other context.

With the possible exception of wartime conditions, the federal government has not instituted an explicit minerals policy and planning program. Some observers have pointed to this condition as evidence of the failure of the Act of 1970. Others suggest that minerals policy is best left undefined, except in very unusual circumstances. Instead, they say, we should allow the market to force decisions that will, by the nature of market operations, provide a secure, adequate, and relatively cheap flow of minerals to consumers. Others suggest that changing geographic distribution and political availability of economic mineral deposits, declining grades of ore, increased energy costs, and environmental concern about the use of air, water, and land have changed the conditions of mineral supply and use so dramatically that the initiation of a comprehensive minerals policy is essential if any other economic, social, or energy policy is to succeed. For national decision making to be effectively influenced by minerals supply considerations, they argue that dramatic changes must take place in the planning and implementation of minerals policy.

GAO has recently reviewed the dynamic factors that must be present for policy initiatives to succeed.[12] The factors mentioned include the development of planning goals, a cooperative and coordinated policy organization, the construction of institutional arrangements required to execute policy, and the assignment of responsibility for setting policy direction. This committee suggests a further factor--an oversight review that clearly must occur at the highest level of the executive branch. Only at this level can coordinated government policy have a chance to succeed in so complex a venture. Only from the executive office can the separate interests of federal agencies, the public interests of the citizenry, and the private interest of the minerals industry be reconciled into an effective policy structure. Although chances for success may appear improbable and unattainable, the evolving concerns and potential conflicts centered on mineral resources seem too great to ignore.

MINING AND MINERALS POLICY ACT IN RETROSPECT

The National Academy of Sciences COMRATE review of the annual reports led to other perceptions that are relevant to the current discussion. Generalized statements of broad policy goals, customarily encompassed in legislation, make the development of a framework for policy analysis difficult. By their very nature, these legislative statements contain too many ambiguities and inconsistencies to serve as adequate guidelines for selecting the best policy alternatives. For example, there may well be seemingly unresolvable incompatibilities in policy goals that require a secure, environmentally acceptable, and efficient materials industry but no interference with traditional private-sector or foreign market mechanisms.

While the goals themselves may be good targets, the road to effective achievement may be littered with the debris of actions that ultimately produced results directly opposite to those intended. The executive branch and the Congress need a framework that provides an effective way to evaluate and compare the impacts of government involvement in mineral and energy markets. At the minimum, therefore, the system must show the interrelations among mineral and energy markets and the rest of the economy.

Another critical factor in a framework for analysis of policy is the ability to link the short- and long-run effects of any action. By definition, long-run assessment must consider, though not exclusively, (1) shifts in patterns of final materials demand; (2) materials substitution; (3) the level and organization of exploration; and (4) technological innovation requiring significant lead time and capital. Short-run considerations will include among many other factors (1) current and potential supply bottlenecks; (2) the level and pace of reserve develop- ment; (3) amelioration of the environmental impacts of mining and processing; and (4) temporary dislocations in market operations.

ALTERNATIVES TO THE 1970 ACT

If the reports under the Mining and Minerals Policy Act of 1970 do not provide a sufficient basis for policy initiation within the federal government, what alternative mechanism might so serve? Whatever the mechanism chosen, it must: (1) coordinate the various federal interests in minerals policy at a level high enough to obtain presidential backing; (2) involve the vital mineral interests and responsibilities of Congress at an early stage of analysis and deliberation; (3) produce an informative and factual analysis of policy alternatives that can stand the test of public and private review; (4) be responsible for the informational and analytical framework used to develop policy alternatives; and (5) have sustained financial and professional support.

Recommendations for a process to achieve these results are given in Chapter 1.

CHAPTER 3

THE ROLE OF INFORMATION AND ANALYSIS IN THE NON-FUEL MINERALS POLICY PROCESS

INTRODUCTION

The General Accounting Office[1,13,14], the presidential and congressional commissions on materials issues[2-4, 15], and the White House studies on non-fuel minerals policy[6] have all concluded that the information and analytical system with respect to materials is deficient. In response to this finding of the President's Materials Policy Commission (the Paley Commission) reported in 1952,[15] substantial actions were undertaken both within and outside of the federal government.

Within the government, the information and analytical systems in the Department of the Interior dealing with mineral resources were substantially altered and improved in a continuing process. In addition, the Paley Commission's recommendations led to the establishment of Resources for the Future, a nonprofit organization designed to provide objective analyses of materials problems. Resources for the Future has produced, and continues to produce, major studies of materials, their characteristics, and the issues surrounding their production and use.

The most recent of the national commissions--the Commission on Supplies and Shortages--was directly charged with the task of reporting on the means by which materials data can be most effectively and economically gathered and coordinated. The commission devoted considerable space in its final report [3,4] to improving data collection and analysis and to a broader perspective of government policy. In addition, the commission supported specific studies on information systems. Its analysis was augmented by contract studies by the Office of Technology Assessment[16] and by a series of General Accounting Office reports on specific aspects of the materials information system[13,14].

Pursuant to the non-fuel minerals policy review, still underway within the executive office of the President, additional studies were done on specific needs for information for various federal land programs for minerals policy in general. The draft report of the findings of that policy review[4] identifies the inadequacy of information as a major issue to be addressed.

In view of this intense examination, which has continued now for 30 years, the contribution of this committee is certain to be somewhat

limited. However, we feel that there are some important things to say about the nature of information in the policy process and the factors that determine the contribution of any information and analytical system to better policy processes.

The committee believes that the reason the federal government has not responded to the advice concerning materials information systems is that there is a lack of understanding of the needs of information and analysis as applied to public decisions. Much effort is expended to develop organizational structures and detailed specifications of data, but those efforts often flounder because of failure to understand the needs of the problem. The following sections of this report demonstrate that it is analytically impossible to design an optimum data system that will fulfill all purposes. It is likewise impossible to design a policy analysis system in organizational terms. The committee feels, in view of these findings, that the most it can recommend is a consolidation of function in the interest of efficiency.

If the reader desires detailed descriptions of the current systems, he is referred to the most recent reports cited above [1,3,6,12,14]. The committee did not feel it appropriate to repeat those details in this report.

In response to the energy issues raised in the mid-1970's, the actions taken by the federal government were to form a new department and a new information agency. Many people, including the present administration, are now questioning the appropriateness of massive organizational response to a policy issue. The committee believes that any organizational response to the identified failings of the materials information system should be limited to those that can be justified on a cost-effectiveness basis.

The remainder of this chapter develops a theoretical basis for analyzing information systems and makes the point that there is no scientific basis for judgment of adequate or optimum systems.

PHILOSOPHICAL BASIS FOR INFORMATION SUPPLY

The Nature of Information

Information is an economic good in that it bears a significant cost of production. As with all economic goods, the devotion of resources to obtaining information must be considered in terms of the contribution of that information to the improved allocation of resources. In other words, the cost of new information must be weighed against its contribution to a more valuable decision. This economic maxim is greatly complicated by the fact that government information, in particular, is a public good and therefore supports general services whose values cannot be captured in terms of the cost of the information. More information is always desired but not always available, so the decision maker must often act though ignorant or uncertain of many aspects of his decision.

The use of the price system to make economic decisions about nonpublic goods and services has a clear advantage over central planning of such decisions. The price system, by isolating the decision maker from most aspects of the problem at hand, greatly economizes on the use of information. On the other hand, central planning of decisions, whether in a large private corporation or in government, places a heavy cost on information services. The persistent complaints of drowning in a sea of paperwork and of the regulatory burden on society flow from the need to provide information required by law. The use and analysis of this information consumes a substantial portion of our Gross National Product. The process also diverts substantial resources from the production of goods and services to the production of information used to make decisions about the production of goods and services.

The Nature of Decisions

The contribution of information to better decisions is a function of the decision itself. Every decision carries with it a requirement for information that can be categorized in some sort of hierarchy of decreasing impact on the decision itself. A decision on whether or not to accept the highest bid on a competitive sale of a lease requires much less information than the decision to offer the lease for sale, which in turn requires much less information than the decision on whether or not the product should be disposed of by lease, etc. Decisions are sequential and the data needs at each step are different.

Information that has relatively high value at one stage may be irrelevant at another. Certainly one's knowledge of the highest bidder and the amount of his bid is not useful in determining the method of disposal of a resource in general. On the other hand, the information and analysis that went into the chain of decisions to hold the sale is irrelevant to the decision maker who is awarding the lease to a bidder.

The Uses of Data

Data describe, in one dimension, something that has happened. The amount of a bid is data. The date that the lease sale was announced, is data. The enactment and content of the Mineral Leasing Act of 1920 are data. Data can be used to describe the past and, through analysis, to understand the past. When combined with analysis based on an understanding of the past, data can be used to draw conclusions about the future. It is the ability of data to further the understanding of the past and to provide a basis for assessing the future that makes it valuable.

However, data are valuable goods only if they make a contribution to decision making. The usefulness of data is determined by the analytical structure within which they are marshalled and used to increase understanding. It was the failure to understand this maxim that led to the early, abortive attempts to build immense, general-purpose data banks. We have an example much closer to the materials planning problem. Failure to understand the basis of the value of data sharply

limits the usefulness of the data systems on minerals maintained in the United States Geological Survey and the U.S. Bureau of Mines. Every book, every computer memory, and every brain contains some useless data. The idea that information systems fail from lack of data is probably, in general, not true. Many information systems fail from a surplus of data.

The Role of Analysis

Stated in its simplest terms, the role of analysis is to identify the data that will make a critical input to a decision. Every decision involves considerations of the impact of that decision on some future event. No decision can modify the past. There must be, then, some mechanism by which the decision maker focuses on his objective and analyzes the data and information available to him to judge the effectiveness of his decision in achieving the objective. In this very real sense, every decision is unique and its data requirements are unique.

It is clear that the data collected and the analytical systems developed for an expensive information and analytical system must meet a wide range of decision needs. It would be costly, if not impossible, however, to have on call the precise data and analytical interpretation or model that would make the maximum contribution to every decision-maker in the public and private sector.

This line of thought leads to a very important conclusion: <u>It is impossible to describe an optimum overall information and analytical system in terms of the data content or a real time analytical system supporting every decision.</u>

In other words, no optimum information system in terms of the necessary types, kinds, and detail of data, or one ideal analytical system in terms of the analytical models can be made available on call for a total resource system that will cover all the various problems that can arise.

In summary, information has value when it contributes to a better decision. Information must be used in a formal and explicit or nonexplicit analytical system that weighs the information in terms of its impact on the decision being made. A general-purpose information system has seldom been able to perform with any degree of specificity.

GENERAL REQUIREMENTS FOR AN INFORMATION AND ANALYSIS SYSTEM

Guidelines

The National Commission on Supplies and Shortages devised ten guidelines for improving data and analysis. It is the opinion of this committee that they are basically sound. The first five guidelines are:

(a) data collection and data analysis should be organizationally separate from policy and program activities; (b) data collection and data analysis should be placed in separate high level (preferably bureau level) organizations of comparable status; (c) the credibility of data and analysis should be maintained through open access, advisory committees, and other institutional safeguards; (d) data collection and analysis should be responsive to the needs of users; and (e) statistical standards should be upgraded, and the limitations of data-- including sampling error, uncertainty, and assumptions--should be published with the data.

These five are data oriented. They reflect the principle that the data should be unbiased and, to the extent possible, verifiable and correct. They also reflect a second principle, that data analysis--aggregation of the data and their use in developing time trends, correlations, and other statistical manipulations--should be done in accordance with statistical criteria for correctness rather than to prove a position.

The committee believes that it is also essential that the non-fuel minerals data collection and analysis be conducted by a balanced staff of professionals including statisticians, commodity experts, modeling specialists, economists, geologists, and mining and mineral engineers.

The second five guidelines are policy oriented. They are: (a) policy analysis should be separated from data collection and data analysis, and from programmatic and promotional responsibilities; (b) policy analysis should be encouraged at various levels within line departments; (c) policy analysis should be made public, when possible; (d) each policy analyst should work from comparable and consistent data; and (e) the primary responsibility of higher-level policy analysts should be to reconcile conflicting analyses. It is the committee's impression that policy analysis is conducted within the federal government for two quite different reasons. Some policy analysis is done to help the decision maker decide what to do. However, very often policy analyses are conducted to defend a decision after it is made or to defend a recommendation made to a decision maker. The thrust of the second five guidelines seems to be that an independent policy analysis organization is needed to provide the necessary objectivity.

The Existing Materials Information and Data Analysis System

Three organizations in the federal government have as significant parts of their missions the furnishing of materials information and data analysis. These are the Bureau of Mines and the Geological Survey in the Department of the Interior and the Office of Business Analysis in the Department of Commerce. Many other agencies provide materials information and data analysis as subsidiary parts of their missions. These agencies include the Bureau of the Census, the Bureau of Labor Statistics, the Department of State, the Department of the Treasury, the Department of Defense, the Environmental Protection Agency, the Occupational Safety and Health Administration.

Several offices, as a primary mission, provide formal policy analysis on materials issues within the context of their organizations. These offices include the office of Mineral Policy Research and Development under the Assistant Secretary for Minerals of the Department of the Interior; the various offices of policy analysis attached to the Secretaries of State, Interior, Treasury, and Commerce; the Office of Science and Technology Policy and the Council of Economic Advisers in the executive office of the President; and congressional units such as the General Accounting Office, the Congressional Research Service, and the Congressional Budget Office.

When the existing materials information and data analysis system is examined in light of the guidelines in the previous section, it is clear that the system is not responsive to either the data-oriented or policy-oriented guidelines. The question is whether or not the cost of establishing a materials information system that does conform to the guidelines is warranted in terms of improved decisions.

Since the demonstration of improved decision making is difficult at best, recommendations can rest on two justifications involving cost and policy analysis. If it can be demonstrated that a new organization dealing with information and data analysis can provide improved services at the current costs, such a move can be recommended independently of its evaluation of the impact on decision making. The argument is simply one of efficiency. However, the justification with respect to policy analysis is much more difficult and subjective.

The Cost of the Current Information and Data Analysis System

The exact current level of expenditures for information and data analysis systems in the several agencies referred to above is unquantified, but is believed to run in the neighborhood of $100 million annually. This committee believes that although there would be some monetary cost and perhaps other adjustments involved in bringing about a combination of functions, consolidation of these information and data analysis functions would provide increased efficiency in terms of quality and effectiveness.

The Existing Policy Analysis System

Every federal decision maker needs a policy analysis capability to meet the responsibilities of the authority vested in him. There is no basis, then, for urging a central policy analysis organization dealing with materials. However, the thrust of the guidelines on policy analysis is that issues that involve coordination with other decision makers, and that are raised to the level of the executive branch and ultimately, perhaps, of the Congress, do require an analysis of the policy analyses that were used as the basis for the multiple decisions.

Throughout the studies of non-fuel minerals problems made in the past 30 years runs a constant theme: that non-fuel minerals issues are not properly considered in decisions that have non-fuel minerals impacts but do not have non-fuel minerals-oriented objectives. This is the kind of concern that led to the establishment of a formal decision structure in the environmental area. However, this committee finds that the cost entailed by the failure of the decision process in non-fuel minerals is not exceptionally large. Certainly it is not large enough to warrant heavy expenditures of resources to establish a new large-scale formal decision structure for non-fuel minerals. Conversely, advantages could be gained if a relatively modest expenditure would avoid major, unintended consequences for non-fuel minerals caused by actions in other decision systems. Responsibility for monitoring the non-fuel minerals supply system in an existing executive group at the White House should aid in achieving the latter situation.

References

1. The Comptroller General, U.S. General Accounting Office. Learning to Look Ahead: The Need for a National Materials Policy and Planning Process, Report No. EMD-79-30, April 19, 1979, 59 pp.

2. National Commission on Materials Policy. Materials Needs and the Environment Today and Tomorrow. Washington, D.C., U.S. Government Printing Office, 1973.

3. U.S. National Commission on Supplies and Shortages. Forging America's Future. U.S. Government Printing Office, Washington, D.C., 1977, 211 pp.

4. U.S. National Commission on Supplies and Shortages. Government and the Nation's Resources. U.S. Government Printing Office, Washington, D.C., 1977.

5. U.S. National Commission on Supplies and Shortages. Information System Studies, December 1976. LCC Card No. 77-600005, U.S. Government Printing Office, Washington, D.C., 454 pp.

6. Anon., Report on the Issues Identified in the Nonfuel Minerals Review; Background Papers: Draft for Public Review and Comment on the Report on Nonfuel Minerals Policy Review, August, 1979.

7. The Comptroller General, U.S. General Accounting Office, United States-Japan Trade: Issues and Problems, Report No. ID-79-53, September 21, 1979, 205 pp.

8. The Comptroller General, U.S. General Accounting Office, Phosphates: A Case Study of a Valuable, Depleting Mineral in America, Report No. EMD-80-21, November 30, 1979, 71 pp.

9. U.S. Congress, Senate. Committee on Energy and Natural Resources. Subcommittee on Energy and Natural Resources Production. Hearings on H.R. 2743, The National Materials and Minerals Policy, Research and Development of Act of 1980. 96th Congress, 2nd Session, Washington, D.C., July 1980.

10. U.S. Congress. National Materials and Minerals Policy, Research and Development Act of 1980. Public Law 96-479. 96th Congress, 2nd Session. October 22, 1980.

11. Secretary of the Interior Mining and Minerals Policy, Annual Reports of the Secretary of the Interior Under the Mining and Minerals Policy Act of 1970 (Public Law 91-631), March 1972; June 1973; May 1975; July 1976; July 1977; June 1979.

12. Comptroller General of the United States, Federal Materials Research and Development: Modernizing Institutions and Management. Washington, D.C., General Accounting Office, Report No. OSP-76-9, 1975, 68 pp.

13 The Comptroller General, U.S. General Accounting Office, The Department of the Interior's Computerized Resources Information Bank, Report No. EMD-78-17, July 17, 1978.

14. The Comptroller General, U.S. General Accounting Office. The Department of the Interior's Minerals Availability System, Report No. EMD-78-16, July 17, 1978.

15. The President's Materials Policy Commission (The Paley Commission). Resources for Freedom. U.S. Government Printing Office, Washington, D.C., 1952 (5 Volumes) 819 pp.

16. Office of Technology Assessment. An Assessment of Materials Information Systems Capabilities Required to Support U.S. Materials Policy Decisions. December 1, 1976, 249 pp.

17. Commission on Natural Resources, National Research Council. Committee on Mineral Resources and the Environment (COMRATE). Mineral Resources and the Environment, National Academy of Sciences, Washington, D.C., 1975, 348 pp.

18. Committee on the Survey of Materials Science and Engineering (COSMAT). Materials and Mans Needs: Materials Science and Engineering. Washington, D.C., National Academy of Sciences, 1974, 214 pp.

19. National Academy of Sciences, National Academy of Engineering, Environmental Studies Board. Man, Materials, and Environment. Cambridge, Mass., The MIT Press, 1973, 236 pp.

20. National Academy of Sciences. National Materials Policy. Washington, D.C., 1975, 215 pp.

21. National Academy of Sciences-National Research Council. Committee on Resources and Man. Resources and Man. San Francisco, California, W.H. Freeman and Company, 1969, 259 pp.

22. National Materials Advisory Board. Elements of a National Materials Policy. Washington, D.C., National Academy of Sciences - National Research Council, 1972, 66 pp.

23. Vogely, W.A. and Tilton, J.E., Report on Phase I: Domestic Policy Review of Nonfuel Minerals. Volume III. Compendium of Issues, Options and Recommendations Contained in Major Post-War Nonfuel Mineral Policy Studies, U.S. Government Printing Office, Washington, D.C., 1979, 606-441-18, 833 pp.